

#### REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Office Action dated November 28, 2006, and in conjunction with the Request for Continued Examination being filed herewith.. In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

#### Status of the Claims

As outlined above, claims 1, 5, 7-10, 13-14, 16, and 18-26 stand for consideration in this application, wherein 1, 5, 7-10, 13, 19-20 and 23 claims are being amended to correct formal errors and to more particularly point out and distinctly claim the subject invention. In addition, new claims 24-26 are hereby submitted for consideration.

All amendments to the application are fully supported therein, including page 4, lines 23-28 and page 5, lines 7-15 of the specification. Applicants hereby submit that no new matter is being introduced into the application through the submission of this response.

#### Formal Rejections

Claims 1, 5, 7-10, 13-14, 16 and 18-23 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

Claims 1, 5, 19, 20, and 23 are being amended so as to be definite and to more particularly point out and distinctly claim the subject matter of the claimed invention. Accordingly, dependent claims 7-10, 13-14, 16, 18 and 21-22 now more particularly point out and distinctly claim the subject matter of the claimed invention. Accordingly, withdrawal of the formal rejections is respectfully requested.

#### Prior Art Rejections

##### The First 35 U.S.C. §103(a) rejection

Claims 1, 5, 7, 8, 13, 14, 16, 18-20 and 23 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Mullee (U.S. Pat. 6,306,564) in view of Vaartstra (U.S. Pat. 6,242,165) and Skee et al. (U.S. Pat. 5,989,353). This rejection is respectfully traversed for the reasons set forth below.

#### Claim 1

Claim 1 as amended recites that a composition for removing residues from the microstructure of an object comprises carbon dioxide; an additive for removing the residues comprising a fluoride having a formula  $\text{NR}_1\text{R}_2\text{R}_3\text{R}_4\text{F}$ , where each of  $\text{R}_1$ ,  $\text{R}_2$ ,  $\text{R}_3$ , and  $\text{R}_4$  is an alkyl group, and a basic compound including a quaternary ammonium hydroxide; and a co-solvent for dissolving said additive in said  $\text{CO}_2$  at a pressurized fluid condition, wherein at least said carbon dioxide is in a supercritical state so as to maintain the composition comprising said carbon dioxide, said additive and said co-solvent as a single composition and wherein weight percents of said carbon dioxide, said additive and said co-solvent are such that the composition comprising said carbon dioxide, said additive and said co-solvent effectively penetrates the microstructure.

A composition as recited in claim 1 is directed to a composition which effectively removes residues on the surface of a microstructure such as, but not limited to, a fine patterned semiconductor wafer. Supercritical  $\text{CO}_2$  at a pressurized condition is effective to remove residues on a microstructure because of its low viscosity. However, supercritical  $\text{CO}_2$  alone is not enough to remove the residues. Applicants found that the residues on the surface of a fine patterned semiconductor wafer can be removed more effectively by adding an additive as recited in claim 1 where the additive is dissolved in the pressurized  $\text{CO}_2$  in a fluid condition. The additive as recited in claim 1 can be dissolved or dispersed homogeneously in the pressurized  $\text{CO}_2$  in a fluid condition by a co-solvent as recited in claim 1 because the co-solvent has affinity to both  $\text{CO}_2$  and the additive recited in claim 1 (page 4, line 31 – page 5, line 1 of the specification). In other words, the co-solvent recited in claim 1 enables the maintaining of the carbon dioxide in a supercritical state and the additive as recited in claim 1 as a single composition. The amount of the co-solvent depends on the amount of the additive to be dissolved. As the amount of the additive is increased, the amount of the co-solvent needs to be increased. However, if the amount of the co-solvent is increased too much, the amount of  $\text{CO}_2$  needs to be decreased, and therefore, the penetration of the composition decreases. Therefore, as recited in claim 1, the weight percents of said carbon dioxide, said additive and said co-solvent must be such that the composition comprising said carbon dioxide, said additive and said co-solvent effectively penetrates the microstructure.

In contrast, Mullee uses an organic solvent to remove organic contaminants from the wafer surface (col. 4, lines 21-24), not to dissolve additional chemicals such as in supercritical CO<sub>2</sub> in a fluid condition. In other words, Mullee does not show or suggest using to use the organic solvent to dissolve amine in supercritical CO<sub>2</sub> in a fluid condition. Therefore, Mullee does not provide one of ordinary skill in the art any motivation to provide that at least said carbon dioxide is in a supercritical state so as to maintain the composition comprising said carbon dioxide, said additive and said co-solvent as a single composition with set the weight percents of carbon dioxide, chemicals such as amine and an organic solvent being set such that the composition comprising the carbon dioxide, the chemicals such as amine and the organic solvent effectively penetrates the microstructure, as recited in claim 1.

The secondary reference of Vaartstra merely shows applying a composition comprising supercritical CO<sub>2</sub>, tetramethyl ammonium fluoride and an oxidizer to the surface of a wafer. The oxidizer such as sulfur trioxide is applied to remove the organic material, not to dissolve ammonium fluoride in the CO<sub>2</sub> in a fluid condition. The secondary reference of Skee merely shows that a composition to remove metal contamination on the surface of a wafer comprises alkaline solution such as tetramethylalkyl ammonium hydroxide, tetraethyl ammonium hydroxide, methyl-1, 5-pentanediamine, and monoethanolamine. Therefore, neither Vaartstra nor Skee provides one of ordinary skill in the art any motivation to have at least said carbon dioxide in a supercritical state so as to maintain the composition comprising said carbon dioxide, said additive and said co-solvent as a single composition and the composition comprises the co-solvent and weighs percents of carbon dioxide, chemicals such as amine and an organic solvent such that the composition comprising the carbon dioxide, the chemicals such as amine and the organic solvent effectively penetrates the microstructure as recited in claim 1.

In sum, the mere fact that Mullee, Vaartstra and Skee can be combined or modified does not render the resultant combination obvious because one of ordinary skill in the art would not have any motivation or desirability to combine Mullee, Vaartstra and Skee by knowing the disclosure of Mullee, Vaartstra and Skee.

Accordingly, claim 1 is not obvious in view of all the prior art cited.

Claims 5, 19, 20, 23

Claims 5, 19, 20 and 23 have substantially the same features as those of claim 1, at least with respect to a composition comprising a carbon dioxide, an additive comprising an additive for removing the residues comprising a fluoride having a formula  $\text{NR}_1\text{R}_2\text{R}_3\text{R}_4\text{F}$ , where each of  $\text{R}_1$ ,  $\text{R}_2$ ,  $\text{R}_3$ , and  $\text{R}_4$  is an alkyl group, and a quaternary ammonium hydroxide; and a co-solvent for dissolving said additive in said  $\text{CO}_2$  at a pressurized fluid condition, wherein at least said carbon dioxide is in a supercritical state so as to maintain the composition comprising said carbon dioxide, said additive and said co-solvent as a single composition and wherein weight percents of said carbon dioxide, said additive and said co-solvent are such that the composition comprising said carbon dioxide, said additive and said co-solvent effectively penetrates the microstructure. As such, the arguments set forth above are equally applicable here. Claim 1 being allowable, claims 5, 19, 20 and 23 must also be allowable.

Particularly, claim 20 recites the range in the amount of an additive and the range in the amount of a co-solvent are specifically recited. Sufficient penetration of  $\text{CO}_2$  into the surface of the object to remove residue on the surface of the object can be achieved by setting the amount of the additive and the co-solvent in the ranges recited in claims 20 (page 4, lines 23-28 of the specification). None of Mullee, Vaartstra and Skee shows or suggest, explicitly or implicitly, setting the amount of the additive and co-solvent as recited in claim 20. Accordingly, claim 20 is not obvious over the all the prior art cited.

#### Claims 7-8, 13-14, 16, 18

As to dependent claims 7-8, 13-14, 16 and 18, the arguments set forth above with respect to independent claims 5 and 19 are equally applicable here. The corresponding base claim being allowable, claims 7-8, 13-14, 16 and 18 must also be allowable.

#### The Second 35 U.S.C. §103(a) rejection

Claims 1, 5, 7-10, 16, 18-20 and 23 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over WO 01/33613 (WO '613) in view of Vaartstra and Skee. This rejection is respectfully traversed for the reasons set forth below.

#### Claim 1

WO '613 merely shows applying a solvent such as DMSO, EC, NMP acetylacetone, BLO, acetic acid DMAC, PC and a mixture thereof to dissolve the photoresist and the residue

(Abstract: page 5, lines 16-17), not to dissolve fluoride and quaternary ammonium hydroxide in supercritical CO<sub>2</sub> in a fluid condition. In other words, WO '613 does not disclose or suggest using the organic solvent to dissolve amine in supercritical CO<sub>2</sub> in a fluid condition. Therefore, WO '613 does not provide one of ordinary skill in the art any motivation to provide at least said carbon dioxide in a supercritical state so as to maintain the composition comprising said carbon dioxide, said additive and said co-solvent as a single composition and set the weights percents of carbon dioxide, chemicals such as amine and an organic solvent are set such that the composition comprising the carbon dioxide, the chemicals such as amine and the organic solvent effectively penetrates the microstructure, as recited in claim 1.

Regarding Vaarstra and Skee, the arguments set forth above are equally applicable here. As set forth above, the mere fact that WO '613, Vaarstra and Skee can be combined modified does not render the resultant combination obvious.

In sum, there is no suggestion or motivation in either WO '613, Vaarstra or Skee to combine these features explicitly or implicitly, or in the knowledge generally available to one of ordinary skill in the art at the time the invention was made to embody all the features of the invention as recited in claim 1. Accordingly, claim 1 is not obvious in view of all the prior art recited.

#### Claims 5, 19, 20, 23

Claims 5, 19, 20 and 23 have the substantially same features as those of claim 1, at least with respect to a composition comprising a carbon dioxide, an additive comprising an additive for removing the residues comprising a fluoride having a formula NR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>R<sub>4</sub>F, where each R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and R<sub>4</sub> is an alkyl group, and a quaternary ammonium hydroxide; and a co-solvent for dissolving said additive in said CO<sub>2</sub> at a pressurized fluid condition, wherein at least said carbon dioxide is in a supercritical state so as to maintain the composition comprising said carbon dioxide, said additive and said co-solvent as a single composition and wherein weight percents of said carbon dioxide, said additive and said co-solvent are such that the composition comprising said carbon dioxide, said additive and said co-solvent effectively penetrates the microstructure. As such, the arguments set forth above are equally applicable here. Claim 1 being allowable, claims 5, 19, 20 and 23 must also be allowable.

Particularly, claim 20 specifically recites the range in the amount of an additive and the range in the amount of a co-solvent. Sufficient penetration of CO<sub>2</sub> into the surface of the object to remove residue on the surface of the object can be achieved by setting the amount of

the additive and the so-solvent in the ranges recited in claims 19 (page 4, lines 23-28 of the specification). None of WO '613, Vaartstra and Skee shows or suggests, explicitly or implicitly, setting the amount of the additive and co-solvent as recited in claim 20. Accordingly, claim 20 is not obvious over the all the prior art cited.

#### Claims 7-10, 16, 18

As to dependent claims 7-10, 16 and 18, the arguments set forth above with respect to independent claims 5, 19 are equally applicable here. The corresponding base claim being allowable, claims 7-10, 16 and 18 must also be allowable.

#### The Third 35 U.S.C. §103(a) rejection

Claims 1, 5, 7-10, 13, 14, 16, 18-20 and 23 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Xu et al. (U.S. 2003/0125225) in view of Skee. This rejection is respectfully traversed for the reasons set forth below.

#### Claim 1

Xu merely shows that an additive for removing the residues comprises ammonium fluoride. Xu does not show or suggest that an additive for removing the residues comprises a fluoride having a formula  $NR_1R_2R_3R_4F$ , where each of  $R_1$ ,  $R_2$ ,  $R_3$ , and  $R_4$  is an alkyl group. As set forth above, the secondary reference of Skee shows a composition to remove metal contamination on the surface of a wafer comprises alkaline solution such as tetramethylalkyl ammonium hydroxide, tetraethyl ammonium hydroxide, methyl-1, 5-pentanediamine, and monoethanolamine. However, Skee does not show that the composition comprises a fluoride having a formula  $NR_1R_2R_3R_4F$ , where each of  $R_1$ ,  $R_2$ ,  $R_3$ , and  $R_4$  is an alkyl group.

In sum, there is no suggestion or motivation in either Xu or Skee to combine these features explicitly or implicitly, or in the knowledge generally available to one of ordinary skill in the art at the time the invention was made to embody all the features of the invention as recited in claim 1. Accordingly, claim 1 is not obvious in view of all the prior art recited.

#### Claims 5, 19, 20, 23

Claims 5, 19, 20 and 23 have substantially the same features as those of claim 1, at least with respect to a composition comprising a carbon dioxide, an additive comprising an additive for removing the residues comprising a fluoride having a formula  $NR_1R_2R_3R_4F$ ,

where R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and R<sub>4</sub> are each independently an alkyl group, and a quaternary ammonium hydroxide; and a co-solvent for dissolving said additive in said CO<sub>2</sub> at a pressurized fluid condition, wherein at least said carbon dioxide is in a supercritical state so as to maintain the composition comprising said carbon dioxide, said additive and said co-solvent as a single composition and wherein weight percents of said carbon dioxide, said additive and said co-solvent are such that the composition comprising said carbon dioxide, said additive and said co-solvent effectively penetrates the microstructure. As such, the arguments set forth above are equally applicable here. Claim 1 being allowable, claims 5, 19, 20 and 23 must also be allowable.

Particularly, claim 20 specifically recites the range in the amount of an additive and the range in the amount of a co-solvent. Sufficient penetration of CO<sub>2</sub> into the surface of the object to remove residue on the surface of the object can be achieved by setting the amount of the additive and the co-solvent in the ranges recited in claims 19 (page 4, lines 23-28 of the specification). Neither Xu nor Skee shows or suggests explicitly or implicitly setting the amount of the additive and co-solvent as recited in claim 20. Accordingly, claim 20 is not obvious over the all the prior art cited.

#### Claims 7-10, 13-14, 16, 18

As to dependent claims 7-10, 13-14, 16 and 18, the arguments set forth above with respect to independent claims 5 and 19 are equally applicable here. The corresponding base claim being allowable, claims 7-10, 13-14, 16 and 18 must also be allowable.

#### The Fourth 35 U.S.C. §103(a) rejection

Claims 21 and 22 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Mullee in view of Vaarstra and Skee, WO '613 in view of Vaarstra and Skee, or Xu in view of Skee, and further in view of McCullough. This rejection is respectfully traversed for the reasons set forth below.

As set forth above, there is no suggestion or motivation in any of Mullee, Vaarstra, Skee, WO '613 or Xu to combine their features explicitly or implicitly, or in the knowledge generally available to one of ordinary skill in the art at the time the invention was made to embody all the features of the invention as recited in claim 20, from which claims 21 and 22 depend. The secondary reference of McCullough fails to provide any disclosure, teaching or suggestion that make up for the deficiencies in Mullee, Vaarstra, Skee, WO '613, Xu and

the knowledge generally available to one of ordinary skill in the art at the time the invention was made. Accordingly, claims 21 and 22 must be allowable.

#### The Fifth 35 U.S.C. §103(a) rejection

Claim 9 was rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over Mullee in view of Vaarstra and further in view of McCullough or WO '613. This rejection is respectfully traversed for the reasons set forth below.

As set forth above, there is no suggestion or motivation in any of Mullee, Vaarstra, Skee, WO '613 or McCullough to combine their features explicitly or implicitly, or in the knowledge generally available to one of ordinary skill in the art at the time the invention was made to embody all the features of the invention as recited in claim 5, from which claim 9 depends. Accordingly, claim 9 must be allowable.

#### New claims 24-26

As to new claims 24-26, the arguments set forth above with respect to claims 1, 5 and 19 are equally applicable here. The corresponding base claim being allowable, claims 24-26 must also be allowable. Also, claims 24-26 have the substantially the same features as those of claim 19, at least with respect to the range in the amount of an additive and the range for the amount of a co-solvent. As such, the arguments set forth above regarding claim 19 are equally applicable here. Claim 19 being allowable, claims 24-26 must also be allowable.

#### Conclusion

In view of all the above, Applicants respectfully submit that certain clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references upon which the rejections in the Office Action rely. These differences are more than sufficient that the present invention as now claimed would not have been anticipated nor rendered obvious given the prior art. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

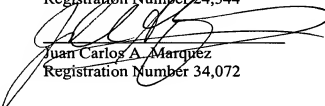
Favorable reconsideration of this application as amended is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the



prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

Respectfully submitted,

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**May 29, 2007**  
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